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THE "PRINT"-STUDY - A 36 WEEK - PROTEIN-ENERGY-INTERVENTION FOR IMPROVING THE NUTRITIONAL STATUS OF GERIATRIC PATIENTS

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Abstract: *Background:* Little is known about the protein needs of diseased elderly. Geriatric patients often eat less and are therefore not adequately nourished. *Objective:* The PRINT (PRotein INTervention)-Study evaluated, in a 36 weeks intervention, if it is possible to increase the protein-energy-intake of institutionalized geriatric patients through protein-energy-optimized meals and if these arrangements could help to improve the nutritional status. *Design:* A controlled parallel intervention trial. It compares the protein-energy- intake of geriatric patients from protein-energy-optimized meals (intervention group) with common meals (control croup) served from the catering- service-system of a geriatric hospital. *Setting:* Geriatric hospital in Vienna. *Participants:* Included: Patients with oral food intake. Excluded: Patients with enteral or parenteral nutrition or taking supplements. 144 geriatric patients with a mean age of 84.9 (± 9.3) years gave their consent to take part in the study.16.6% were men and 83.4% were woman. 82 patients with a mean age of 84.2 (±9.5) years completed the intervention-protocol. *Intervention:* The intervention was realized with two arrangements. Arrangement 1 (week 1 to 36): Protein optimization of the daily served soups, purees or desserts by adding additional eggs, whipping cream or soured cream (≈ 4g protein/person/d). Arrangement 2 (week 23 to 36): Protein optimization through an additionally daily served cup of milk (200ml) (≈ 8g protein/person/d). With both arrangements together, according the calculation-plan, a mean protein optimization of ≈12g protein/d was reached. *Measurements:* Protein-energy- intakes were assessed by means of 3-day-weighing records at week 1, week 20 and week 36 of intervention-time. Albumin, serum total protein and bodyweight were taken from the medical report at week 1, week 20 and week 36 of intervention-time. The non-parametric Friedman test for repeated measurements was used to establish the differences within the groups (sig. $p<0.05$). *Results:* In the intervention group protein/energy intake increased significantly ($p<0.001$/$p<0.001$), serum total protein concentrations increased significantly ($p=<0.01$) and bodyweight was kept constant ($p= 0.993$). In the control group protein/energy intake ($p<0.001$/$p<0.001$) and bodyweight ($p< 0.05$) decreased significantly. During intervention- time 12% of the intervention and 20% of the control participants died. *Discussion:* For geriatric patients a low-dose, long-term protein-energy-addition to the daily meals provision of the catering-system-service could help to improve their protein-energy-intake and nutritional status.

Key words: Geriatric-patients, protein-energy-intake, bodyweight, bloods-total-protein, nutritional-status.

Introduction

Old and very old people eat less, often show a reduced appetite and unbalanced eating habits (1, 2). Due to a reduced food intake also protein-energy intake is reduced, too. Hence, the protein-energy intake through daily food and meals should be a main concern in the nutrition of this age group. This is particularly important, because on the one hand protein intake with meals provides the fundamental prerequisite for protein synthesis, dietary derived amino acids (3) and on the other hand sufficient energy intake assures that the protein ingested is used for preservation of lean body mass, body functions and health and not wasted to meet the daily energy requirements (4, 5).

Furthermore, the issue of adequate protein intake is complicated by the fact that until now very little is known about the specific protein needs of frail and diseased elderly. Discussion is ongoing whether the current recommendation for protein intake of 0.8g/kg bodyweight/day for healthy adults is also adequate for frail and diseased elderly (4, 6-8). As protein is a key nutrient in the elderly (9) it is argued that a modest increase of the protein intake beyond the recommended intake of 0,8g/kg/KG should be considered (3, 9, 10). Elevated protein-intake could be of benefit to prevent

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protein-energy-malnutrition (PEM) (1, 2, 11), which is associated with an increased risk of morbidity and mortality (12-14) but also influenced by multiple factors (5, 13, 15, 16).

The staffs of catering-service-systems of geriatric institutions are challenged daily by these facts (2, 17-19). On the one hand the meals served should contain enough protein-energy-dense food to assure sufficient protein-energy-intake for fulfilling the nutritional needs of frail and diseased elderly. On the other hand these should meet the physiological and psychological demands of the entrusted residents, meaning to be easily consumed while regarding cultural eating habits (20). For instance, as eating meals is an important part in the daily life of elderly people, the protein-energy-dense food should be incorporated into the seniors feeding plan without affecting their eating habits (19, 21).

However, this is a less well-researched area (13). Neither complete studies nor recommendations for old and very old people exist, which are based on physiological end points (6, 22, 23). Therefore, we planed the PRotein INTervention-Study (PRINT), and hypothesized, that when optimizing meal-components, like soups, purees or desserts, of the daily menu-plan of the catering-service-system by choosing traditional protein-and energy dense foods, the protein-energy-intake of the institutionalized geriatric patients could be improved. Furthermore, we hypothesized that in consequence these arrangements could help to improve the protein-energy-status of the older people.

Objective: The PRINT (PRotein INTervention)-Study evaluated, in a 36 weeks intervention, if it is possible to increase the protein-energy-intake of institutionalized geriatric patients through protein-energy-optimized meals and if these arrangements could help to improve the nutritional status of the patients.

Methods

Design

The PRINT- Study was designed as a controlled parallel intervention trial. It compares the protein-energy-intake of geriatric patients from protein-energy-optimized meals (intervention group) with common meals (control croup) served from the catering- service-system of a geriatric hospital. The protein-energy-optimizing-calculation based on the results of a former study, where a low protein-energy-intake of geriatric patients through the daily meals was observed. In the former study mean protein intake was about 0.7g/kg/BW/day and mean energy intake was about 1230 kcal/day (24, 25). To achieve a protein intake beyond 0.8g/kgBW/d (e.g. 0,9g/kgBW/d), it was calculated that for a 60 kg reference-person (0,2g X 60 = 12g) 12g protein additionally to the usual protein content of the daily meals should be given.

Ethic

The study design has been approved and accepted by the Ethic Committee of the City of Vienna (EK 10-084-VK-NZ; 26.04.2010).

Setting

Geriatric hospital of long-term-care and rehabilitation.

Participants

The residents of a geriatric hospital suffered from multiple chronic diseases and required assistance to perform their daily life activities. The chief physician of the geriatric hospital was asked to name patients that would be willing to participate in the planned intervention. He selected patients without advanced dementia, based on the following criteria.

Excluding criteria

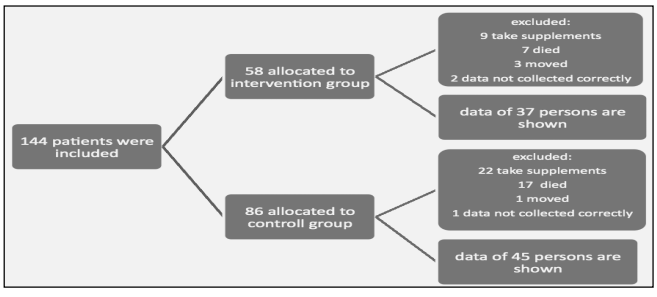
Including: Geriatric patients with oral food intake.

Excluding: Geriatric patients with taking nutritional supplements; geriatric patients receiving enteral or parenteral feeding.

Participants

144 geriatric patients with a mean (±SD) age of 84.9 (± 9.3) years gave their consent to take part in the study.16.6% were male and 83.4% were female. 82 patients with a mean (±SD) age of 84.2 (±9.5) years completed the study and data were evaluated (Figure 1).

Figure 1
Flow-Chart showing the distribution of participants throughout the study-time



Groups

According to the working procedure of the geriatric hospital (21) an intervention and a control group were formed. 58 participants with a mean (±SD) age of 84.5 (±

9.0) years were assigned to the intervention group and 86 participants with a mean age of 85.2 (± 9.5) years were assigned to the control group (Figure 1).

Intervention

The participants of the intervention-group received protein-energy-optimized meals for 36 weeks. The intervention program was planned and realized by the dietician of the geriatric hospital and a nutritionist (researcher, BS). The intervention program consisted of two arrangements. Arrangement 1: Considering that food items like eggs, whipping cream, crème cuisine, soured cream and milk contain an acceptable amount of protein and energy, they were chosen for the optimization of the daily meals, especially as they were also culturally accepted. The dietitian of the geriatric hospital calculated the daily required amount of eggs, whipping cream, crème cuisine, soured cream and milk for optimizing the adequate recipes of the catering-service-menu plan. In such a manner each given portion of the cream soups was additionally optimized with 20g (≈4g protein) egg yolk, the mashed potatoes with 30g (≈0,5g protein) whipping cream, the vegetables with 30g (≈0.5g protein) soured cream or the desserts with 30g (0.5g protein) whipping cream. With this approach a daily food and meal optimization of about an average of 4g protein/person in the intervention group was reached. Arrangement 2: In the intervention-group additional to the daily breakfast an extra cup of milk (150-200 ml) with an average amount of on 6-8g protein was served. Taken both arrangements together (arrangement 1 ≈ 4g protein/day/person and arrangement 2 ≈ 8g protein/day/person) the calculated, additionally 12g protein/day/person could be reached.

Realization

With consideration of the working procedure of the nursing staff from week 1 to week 23 of the intervention-time only the protein optimization of arrangement 1(≈ 4g protein/day) was achieved. As the weighing records, which were done in week 20, showed that the protein-energy-optimization was not adequate to fulfill the study-protocol, additionally arrangement 2 (Intervention) was adopted. So from week 23 to week 36 of the intervention-time both arrangements together (1 and 2) of the protein optimization were put into practice and the calculated optimization of about 12g protein/day/person was reached.

Implementation

The meals of the intervention-group were optimized strictly according to the given implementation protocol. The employees of the catering-service-system were instructed how to optimize the usual recipes. During intervention-time it was not allowed to implement any food-related changes for the control group. The implementation plan and the intervention were explained to the nursing-staff and the doctors. The protein-enriched meals were delivered to the intervention stations through the normal daily working procedures of the catering-service staff. The nursing staff of the intervention stations served the protein-optimized meals in the same manor like the nursing staff of the control stations served the common meals. During the 36 week period, the nutritionist visited the stations weekly assuring that the intervention protocol was realized properly by the nursing staff.

Assessing the protein-energy-uptake

Protein-and energy-intake assessment were done by means of 3-day-weighing records at week 1, week 20 and week 36 of intervention-time. The weighing records were conducted by trained staff, who weighed the plates with the meals before and after the participants` food intakes during the course of the day. The calculation of protein and energy-intake were accomplished with nut.s® nutritional software based on the German Food database BLS 3.01. For the calculation of the protein-and energy intake the mean (±SD) of the 3-day-weighing records was used.

Assessing the protein-energy-status

Bodyweight was taken from the geriatric hospital's medical report of each participant at week 1, week 20 and week 36 of the intervention-time. The routine blood parameters for clinical chemistry (Albumin and blood-plasma-total protein) were assessed at the geriatric hospital's standard laboratory. The data were also taken from the medical report at week 1, week 20 and week 36 of intervention-time.

Statistical analysis

Data were entered and analyzed using the SPSS (Windows version 18.0, SPSS, Inc., Chicago, IL). The non-parametric Friedmann test for repeated measurements was used to establish the differences within the groups. Based on the results of the foregoing study (24) the number of cases evaluation considered a minimum of 22 cases (N) for requiring statistical significant differences (26). A P value <0.05 was considered statistically significant for all analyses.

Results

Mean age of the 37 completers in the intervention group was 84.8 (±7.8) years (76.9% female and 23.1 % male) and mean age of the 45 completers (87% female

Table 1
The daily protein-energy-intake of the geriatric participants at week 1, week 20 and week 36

Intervention-Group	N	Mean (SD)	Range (min.-max.)	p-value	Control-Group N	Mean (SD)	Range	p-value (min.-max.)
Protein intake (absolute)		(g/d)	(g/d)			(g/d)	(g/d)	
Week 1	37	51.1 (±12.9)	32.10-82.90		45	45.8 (±13.9)	19.80-76.50	
Week 20	37	40.3 (±7.2)	22.30-53.60		45	34.9 (±9.8)	14.90-57.10	
Week 36	37	52.2 (±13.2)	28.00-78.50	0.000*	45	35.8 (±12.0)	11.70-55.10	0.000*
Protein intake (per kg/BW)[1]		(g/kgBW/d)[1]	(g/kgBW/d)[1]			(g/kgBW/d)[1]	(g/kgBW/d)[1]	
Week 1	37	0.72 (±0.17)	0.44-1.28		45	0.69 (±0.21)	0.34-1.31	
Week 20	37	0.58 (±0.14)	0.21-0.97		45	0.54 (±0.18)	0.22-1.02	
Week 36	37	0.76 (±0.21)	0.28-1.23	0.000*	45	0.55 (±0.19)	0.20-1.01	0.000*
Energy intake		(kcal/d)	(kcal/d)			(kcal/d)	(kcal/d)	
Week 1	37	1351 (±299)	675-2088		45	1196 (±234)	680-1850	
Week 20	37	1220 (±208)	666-1548		45	1089 (±283)	486-1944	
Week 36	37	1400 (±294)	816-1873	0.000*	45	1006 (±286)	360-1621	0.000*

(*non parametric friedmann-test; sig. Niveau < 0,05); [1](g/kgBW/d)= gram/kgbodyweight/day)

Table 2
Weight and concentration of plasma proteins (albumin and total protein) at week 1, week 20 and week 36

Intervention-Group	N	Mean (±SD)	Range (min.-max.)	p-value	Control-Group N	Mean (±SD) (min.-max.)	Range p-value	
Body-Weight		*(kg)*	*(kg)*			*(kg)*	*(kg)*	
Week 1	37	70.9 (±16.0)	44.0-112.7		45	67.2 (±16.0)	46.0-103.0	
Week 20	37	70.9 (±16.0)	42.1-117.3		45	65.9 (±16.7)	41.3-114.0	
Week 36	37	70.4 (±16.9)	34.3-118.0	0.993	45	65.3 (±16.7)	40.0-114.0	0.016*
Albumin		(g/dl)	(g/dl)			(g/dl)	(g/dl)	
Week 1	37	3.41 (±0.33)	2.3-4.1		45	3.43 (±0.41)	2.3-4.2	
Week 20	37	3.51 (±0.34)	2.5-4.2		45	3.44 (±0.46)	2.0-4.2	
Week 36	37	3.41 (±0.35)	2.5-4.3	0.066	45	3.32 (±0.50)	1.9-4.5	0.162
Total protein		*(g/dl)*	*(g/dl)*			*(g/dl)*	*(g/dl)*	
Week 1	37	6.34 (±0.62)	5.3-7.5		45	6.49 (±0.53)	5.3-7.6	
Week 20	37	6.56 (±0.58)	5.3-7.5		45	6.65 (±0.55)	5.5-7.9	
Week 36	37	6.39 (±0.59)	5.2-7.8	0.006*	45	6.36 (±0.62)	4.8-7.9	0.584

and 13% male) in the control group was 83.7 (± 10.8) years. During intervention-time protein-and energy intake increased significantly in the intervention-group (p<0,001/p<0,001) and decreased significantly in the control-group (p<0,001/p<0,001). In the intervention-group bodyweight remained constant (p=0,993) whereas in the control-group bodyweight decreased significantly (p<0, 05) (Tables 1 and 2). Serum total protein concentrations increased significantly (p<0, 01) in the intervention-group but no significant differences of the concentrations of serum total protein and of albumin were found during intervention-time in the control-group (Table 2). During intervention-time 12% of the intervention participants and 20% of the control participants died. As the protein-energy-optimized meals tasted well the intervention was well tolerated by the geriatric participants.

Discussion

Mainly the PRINT-Study differed in two approaches from other studies in this field. With the background that little is known about the protein needs of diseased elderly generally, (3, 4, 6, 9) we assumed that the protein-energy-undersupply is a systematic problem of the daily meals provision of geriatric institutions and so we included geriatric patients without any categorization (e.g. malnourished or not malnourished) (27-29). Additionally we assumed that a long-time intervention would have the benefit that the obtained results could show long-time effects of a nutritional intervention on the nutritional status of geriatric patients and in consequence to find possibilities of comparison to further studies in this field with a shorter intervention-time (27, 29, 30). So we examined during 36 weeks whether the daily meals provision through the catering-system-service of a geriatric institution is adequate to fulfill the protein-energy-needs of the entrusted residents.

In this context the results of the control-group showed that without serving food and meals adapted to the nutritional needs of the geriatric patients the nutritional status of geriatric patients' declines constantly. The progressive wasting of bodyweight and continuous decline of protein-and-energy-intake in the control-group indicated that when not considering the habitual consumption. the food and meals commonly provided

through the catering-system-service were not adequate to meet the nutritional needs of the entrusted residents.

During the intervention-time the protein-and energy intake of the intervention-group improved, although a protein intake beyond 0,8g/kgBW/d was still not reached. However, the improved protein- and energy-intake was high enough for maintaining bodyweight and improving blood-plasma-total protein of the intervention's participants. Given that the maintained bodyweight and the improved blood-plasma- total protein indicated an improved global nutritional status, the PRINT-Study could show that with a suitable intervention in the food and meals supply of geriatric patients the continuous decline of the nutritional intake and status could be stopped. It was shown that the longtime-optimization of the daily served food and meals could help filling the gap between inadequately and adequately nourished geriatric patients.

Whether the protein-energy-optimization of the PRINT-Study was sufficient for preventing PEM (protein-energy-malnutrition) in a sustainable manner needs further investigations with defined functional outcomes (3, 6, 10, 16). Moreover, randomization or very well-matched control group, larger sample size, longer follow-up, and outcomes related to daily functions or cardiovascular status would be desirable. But, as PEM (protein-energy-malnutrition) is associated with an increased risk of morbidity-and mortality rate it could be hypothesized that the improved nutritional status in the intervention group could help to survive, as it was indicated by the reduced mortality rate in the intervention group.

Finally, like Castellanos et al (31), we provided the additional nutrients in form of foods and meals that the residents like and also we observed that our old geriatric participants appreciate this approach. They eat the optimized traditional foods and meals even after the 36 week intervention-time.

In conclusion, the results of the PRINT-Study showed, that a long-term, low dose protein-energy-improvement of the daily meals provision with easily consumed, traditional and protein-rich foods served through the catering-service-system of a geriatric hospital lead to an improvement of the protein-energy-intake and in consequence to an improvement of the global nutritional status of the geriatric patients.

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Conflict interest: The authors have no conflict of interest to disclose.

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